Outdoor All-Terrain Autonomous Navigation Robot with GPS-IMU

Jaguar

User Guide

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I. Specifications

Jaguar Mobile Robotic Platform is designed for indoor and outdoor operation. It comes with two articulated arms and is fully wirelessly (802.11G) connected. It integrates outdoor GPS, 6DOF IMU and digital compass for autonomous navigation. Jaguar platform is rugged, light weight (< 22Kg), compact, weather and water resistant. It is designed for extreme terrains and capable of climbing up stairs. The integrated high resolution video/audio and laser scanner provide remote operator detail information of the surrounding. Besides the ready to use control and navigation software, a full development kit including SDK, data protocol and sample codes, is also available.

Key Features

- Rugged and reliable mobile platform for indoor and outdoor applications with excellent handling and mobility
- With two synchronized (or optional independently controlled) articulated arms
- Indoor and outdoor operation for extreme terrains
- Weather and water resistant enclosure
- Climbing up 45° slope or stairs (max 200mm or 8")
- Light weight (<22Kg) and compact design with large payload capacity and robust maneuverability
- Autonomous navigation with outdoor GPS + 6DOF IMU and digital compass
- Managing max 200mm (8") vertical step (obstacle)
- Rugged and reliable with shock absorbing suspension
- Integrated Laser scanner (Optional)
- Integrated high resolution video camera with audio
- All 802.11G (802.11N optional) wirelessly connected
- Head mounted display and joystick control providing outdoor operation with large and clear view even under direct sunlight
- Ready to use control and navigation software
- Full development kit including SDK, data protocol and sample codes, support Microsoft® Robotics Studio, Microsoft® Visual Studio, NI LabVIEW®, MATLAB®, Java®

Mobility

Terrain: Sand, rock, concrete, gravel, grass, soil and others wet and dry
Slope: max 45°
Maximum vertical step: 200mm (8")
Stair climbing: Max stair step height 200mm (8")
Traverse: > 260mm (10")
Two articulated arms (Standard: synchronized motion; Optional: independent controlled)
Speed: 0 – 5.5Km/hr
Turning radius: 0, min 850mm (33.5") diameter of turning space
Ground clearance: 38mm (1.5")
Operator remote control
Autonomous navigation with GPS + IMU + Compass
Indoor vision landmark GPS (Optional)

Survivability

Sealed weather resistant enclosure
Temperature: -30° to +50°
Shock resistant chassis
Self-correction from flip-over with articulated arms

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Electronics

Motion and sensing controller (PWM, Position and Speed Control)
5Hz GPS, 6DOF IMU and digital compass
Laser scanner (4m or 30m) (Optional)
Temperature sensing & Voltage monitoring
Headlights

Video / Audio

Color Camera (640x480, 15fps) with audio

Communication

WiFi802.11G (Optional WiFi 802.11N)
Ethernet
Serial (RS232)
Long range antenna (Optional)

External Auxiliary Parts

Ethernet
General purpose communication and power port

Operator Control Unit

Game Pad Controller
Head mounted display (Dual 640 x 480), equivalent to 60" display viewed in 2.7m (9 feet) (optional)
Portable computer (optional)
Weight: 500g (without computer)

Power

Rechargeable battery: LiPo 22.2V 10AH
Nominal operation time: 2 hours (Optional 4 hours)

Motor

Track Motors (24V) (After gear down): 2 units
    Max output (x2): Max 80W, 100Kg.cm/track
    Rated current: 2.75A, Max current 16A

Arm Motor (24V): 1 unit
    Max output: Max 80W, 450Kg.cm
    Rated current: 2.75A, Max current 16A

Dimensions

Height: 176mm (7")
Width: 655mm (25.8")
Length 820mm (32.3") (extended arms) / 640 mm (25.2") (folded arms)
Weight: 21.5 Kg (Standard Configuration)

Payload

Carrying Payload: max 15Kg
Dragging Payload: max 50Kg

Application Development

Full development kit including SDK, data protocol and sample codes, support Microsoft® Robotics Studio, Microsoft® Visual Studio, NI LabVIEW®, MATLAB®, Java®

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Jaguar Core Components

JAGUAR-ME	Jaguar Chassis (including motors and encoders)	1
PMS5005-J	Motion and Sensing Controller (Jaguar Version)	1
WFS802G	WiFi 802.11b/g Wireless Module	2
DMD2500	25A (peak 40A) Dual-channel DC Motor Driver Module	2
PMCHR12	DC-DC Power Board	1
AXCAM-A	640x480 Networked Color Camera (max. 30fps) with Two-Way Audio	1
OGPS501	Outdoor GPS Receiver with 5Hz Update Rate and WAAS	1
IMU9000	9 DOF IMU (Gyro/Accelerometer/Compass)	1
WRT802G	802.11b/g wireless AP/router	1
MCR3210	RS232 Interface Module	1
BPN-LP-10	22.2 V 10 AH Li-Polymer Battery Pack	1
LPBC5000	5A Li-Polymer Battery Charger	1
GPC0010	Game Pad Controller	1

Upgrade Options

Laser Scanner (Range 4m)	LAS04M
Laser Scanner (Range 30m)	LAS30M
22.2V 20 AH Li-Polymer Battery Pack	BPN-LP-10
Head Mounted Display (800x600)	HMD8H6H
Host Controller PC	HCPC1008

Please contact support@drrobot.com for custom design and integration inquiry.

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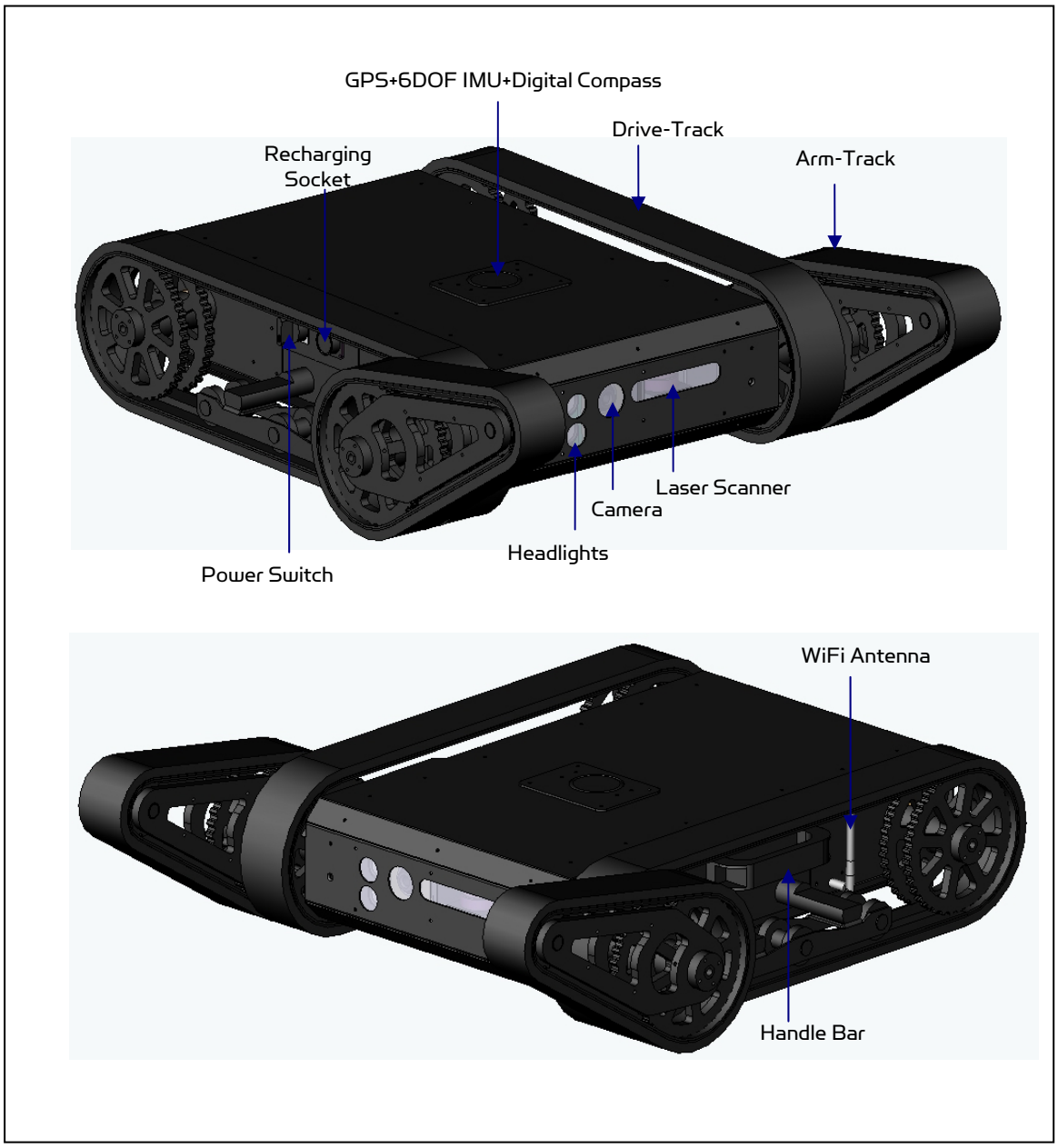
II. Knowing Your Robot

Overlook

The figure below illustrates the key components that you will identify on the Jaguar robot.



Jaguar Platform

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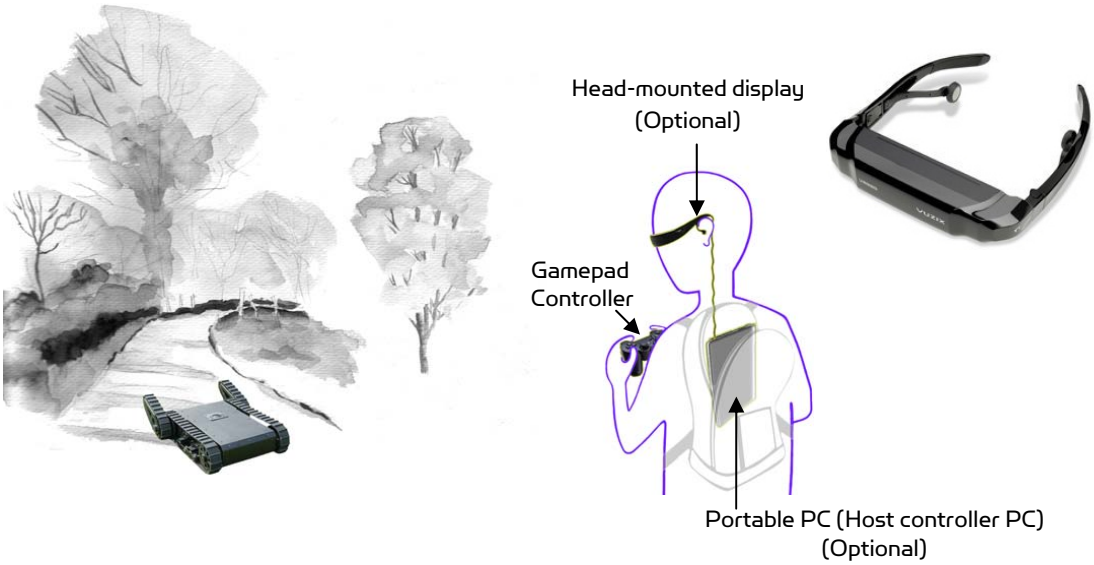
Operation Scenario

Diagram below shows the typical operation scenario. The Jaguar is a wireless networked outdoor mobile robot. It comes with a wireless 802.11 AP/router. The remote host controller PC running the "Jaguar Control" program connects to the Jaguar robot via:

- Network cable – Connect the robot on-board AP/router. (DO NOT connect to the WAN port), or
- Wireless – To connect the host controller PC to the on-robot wireless AP/router, configure the host PC's wireless settings using the default wireless configuration settings found in the Network Connection session of this manual.

Human operator carrying the host controller PC could use the head-mounted display (accessory option) and the included game-pad controller in outdoor environment to monitor and control the operator under any outdoor lighting environment, even under direct sunshine. The included Jaguar control program will therefore be projected on the head-mounted display, where you could see all the sensor information from the robot, and the video streamed from the camera on robot (Please refer to "Jaguar control program" session for detail).



Typical Operation Scenario

Note: The host controller PC running the "Jaguar Control" program could be mounted on the robot instead off the robot if your application requires so.

Software Installation

Jaguar Control programs, application development library and supporting documents could be found from the Jaguar software CD.

On the host controller computer, you should install the following programs from the installation CD:

- **"Jaguar Control" program -** installed by the Setup.exe from CD
- **Google Earth program -** could be downloaded from http://earth.google.com/download-earth.html. Please follow its installation instruction.

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III. Operation of Jaguar Robot

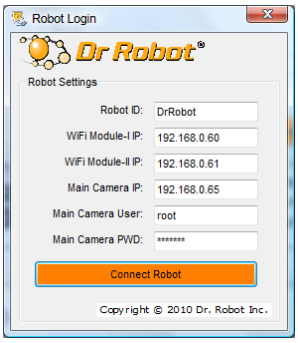
End user could develop his own Jaguar control program using the supplied development API and tools. Here, we are going to discuss how to control the robot using the included "Jaguar Control Program" (You need to install Google Earth program first).

Using Dr Robot Jaguar Control Program

This program will demonstrate how to control to navigate the Jaguar, move the arm-tracks and how to interpret, process, display and log multi-sensor information.

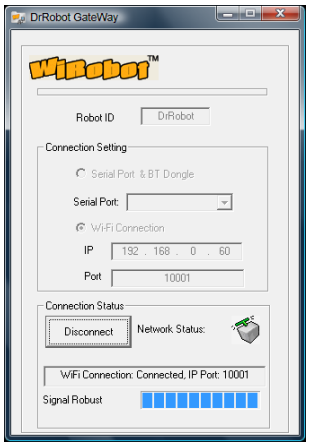
This program provided with source code (c#)

- updates motor encoder reading, motor temperature, board voltage and battery voltage measuring at 10Hz;
- reads and displays IMU and Laser Range sensor data;
- displays GPS reading on the Google Earth;
- displays and controls Axis camera.

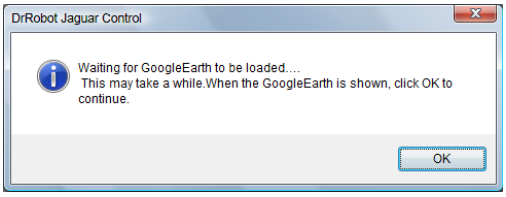


Once you start the program, you will see the "Login Window"

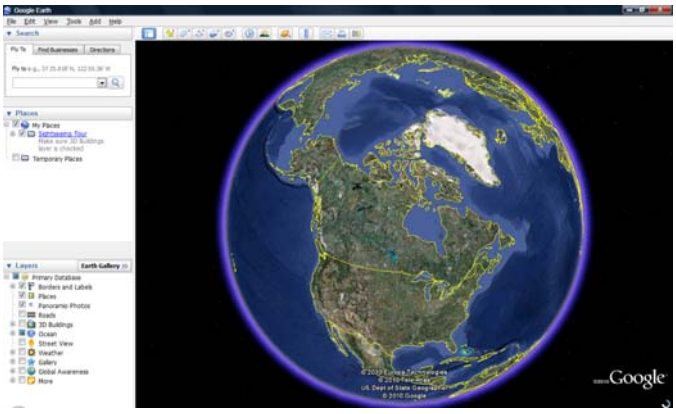
It will read all the configuration information from outdoorrobotconfig.xml in c:\DrRobotAppFile\.



When "Connect Robot" is clicked, it will start the WiRobotGateway program (also in c:\DrRobotAppFile\) and try connecting to the Robot.


DrRobot Jaguar Control
Waiting for GoogleEarth to be loaded....
This may take a while.When the GoogleEarth is shown, click OK to continue.
OK

Google Earth is then loaded and it may take a while.



Google Earth supports offline use (without Internet), but you have to obtain the map online ahead of use.

When Internet is not presented, this loading process will take a longer time for trying to connect with Google Earth website. You will not get the correct Latitude and Longitude position by mouse clicking on map before the map loading is finished. When loaded, click "OK" button.

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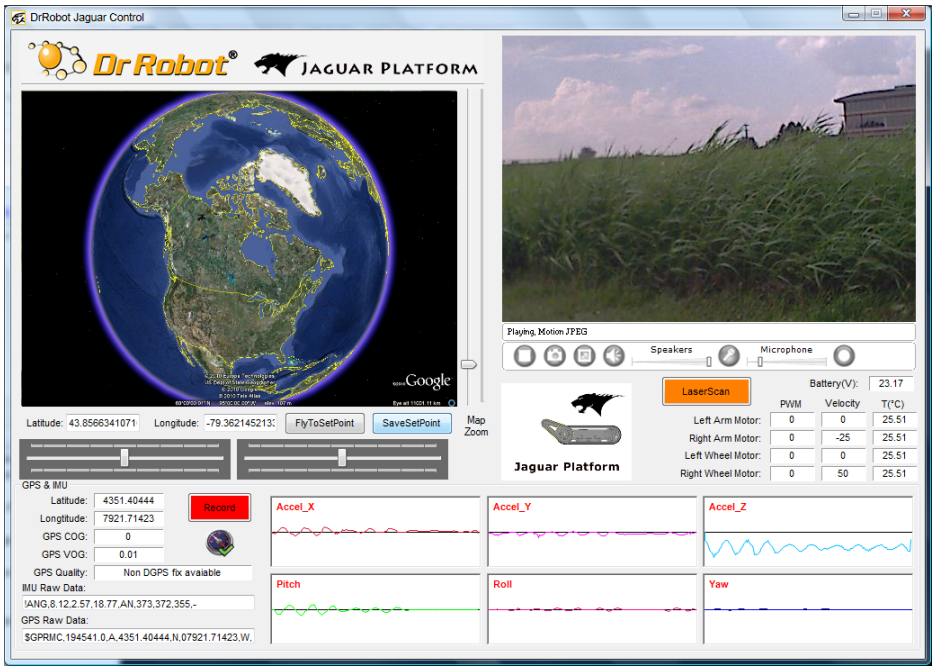
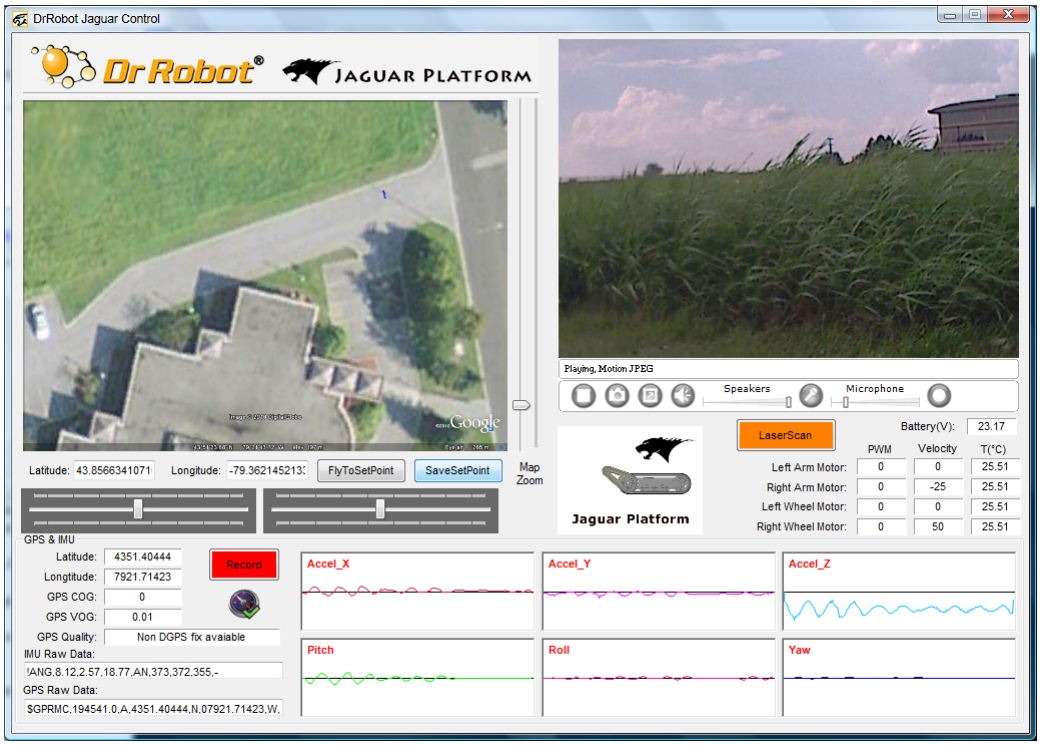


"FlyToSetPoint" button will bring you to the location (latitude/longitude) specified in outdoorrobotconfig.xml. This is the location you would like the map to center and show around. You should modify this location according to your location. This could be done by inputting the value in this xml file or navigating on Google Earth map to your interested point, then clicking "SaveSetPoint" button. The location value of the map center will then be saved to the outdoorrobotconfig.xml when program is closing.



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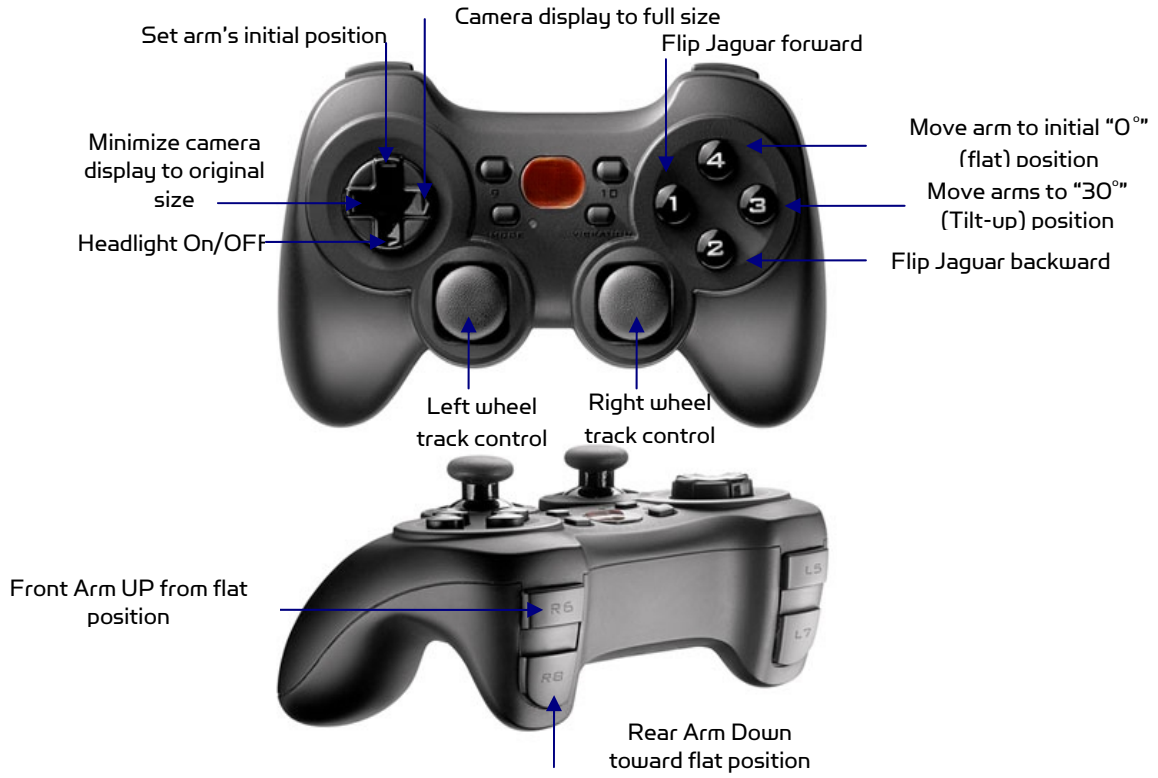
You could use the vertical track bar to zoom in or out.

When the GPS-IMU module is presented, this program will connect and display the GPS information on Google Earth and IMU raw data on the 6 chart boxes.

When camera is presented, the video and Av control buttons will be show in the video window.

You could use the included Game pad controller to navigate the robot. When used outdoor, especially under direct sun lights, head-mounted display (optional accessory) will provide clear and large display for excellent outdoor experience.


Set arm's initial position
Camera display to full size
Flip Jaguar forward
Minimize camera display to original size
Headlight On/OFF
Move arm to initial "0°" (flat) position
Move arms to "30°" (Tilt-up) position
Flip Jaguar backward
Left wheel track control
Right wheel track control
Front Arm UP from flat position
Rear Arm Down toward flat position

Gamepad Control

Note: when using Gamepad control, you need to make sure the program window is in "focus".

Initializing or resetting arm-track position:

After power up, or when the actual arm position is different from the diagram below, you should reset the arm-track position as following:

- drive the arm forward and being flat on the ground, we call this initial or "0" position (extend forward)

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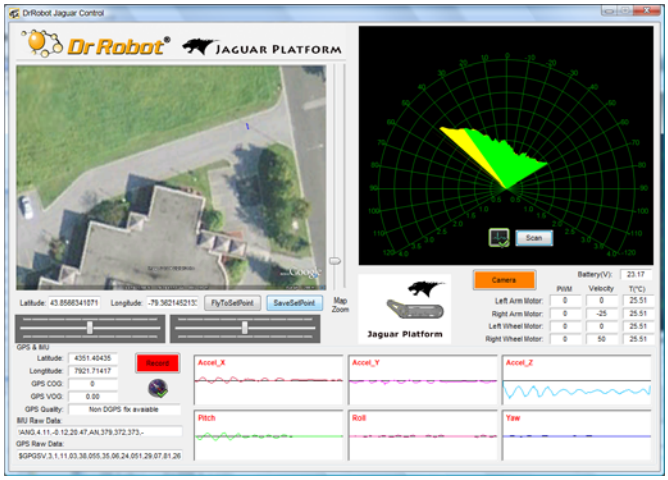
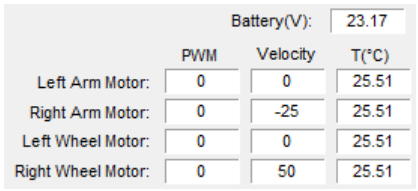
- then, click the "Set arm's initial position" button to save this value and reset arm position display.

Clicking

button, you will display laser scanner data in polar view as shown below.



Battery information and motor information will be displayed in window below:



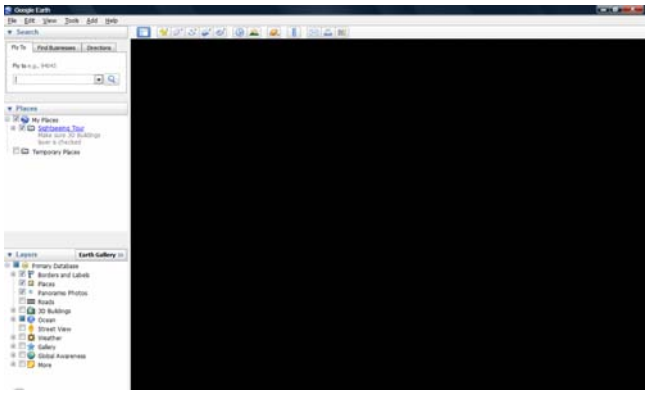
If the robot uses the included Li-Po battery, you need to stop the robot when voltage is below marked voltage (22.2V) to protect battery. Motor temperatures are also displayed in the display. PWM boxes show the PWM values received in motor driver board from motion control board.

The two horizontal track bars show the gamepad left and right stick control value.

You could record raw GPS-IMU/Encoder sensor data by clicking

button. The raw file will be saved under current execution folder with file name GPSIMURec*.txt.

All traces are displayed on Google Earth by KML data. Since the current version of Google Earth does not provide programming method to clear these KML data, there is risk of memory leak. You could manually clear these KML data by: right-clicking on "Temporary Places", then choosing "Delete Contents". (That is why we did not hide Google Earth program)



On normal program exit, Google Earth will be closed. However, you should double check it using "Windows Task Manager", or you may not be able to display Google Earth when you start Jaguar control program again.

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Recharging

Jaguar robot uses high performance LiPo batteries. Extreme caution is needed when dealing with this type of battery, explosion and damage could occur. Please read the Charge Station manual first and follow all the safety rules before proceeding further.

1) Power on the Charge Station. Make sure "LiPo Charge" is displayed on the LCD screen. If not, use "Type/Stop" button to change it to "LiPo Battery".

2) Use "INC" button to choose how to charge battery. You can choose "LiPo Charge", "LiPo Balance" or "LiPo Fast Chg". We recommend using "LiPo Balance" charge to extend battery life and reduce risk.

3) You can use "Enter/Start" + "INC" + "DEC" buttons to change the charge current, DO NOT exceed the 5A charging current and do not modify the battery voltage. It should be "22.2V (6S)" for Jaguar robot.

4) Connect the charging cable to Jaguar charging socket; make sure it is fastened well.

5) Turn the Power switch (CCW) to charge position.

6) Keep pressing "Enter/Start" button for few seconds, the charge station will check the battery and display what the reading is. It should be same as your settings above.

7) If everything is right, you can press "Enter/Start" button again to start charging.

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IV. Hardware and Electronics

Network Settings

Wireless Router Setting

The included pre-configured wireless 802.11 B/G router has the following pre-set settings:

SSID	DriJaguar	**Router LAN**	192.168.0.245
WEP	128bits	**Login ID**	admin
KEY	11223344556677889AABBCCDD	**Password**	drrobot
Key Type	Open Key		

Device Default Network Settings

Note: The WiFi modules are configured for serial-to-Ethernet mode in Jaguar platform.

WiFi Module 1	192.168.0.60
Port 1	Port Number 10001, UDP 115200. 8, N, 1, no flow control
Port 2	Port Number 10002, TCP 115200. 8, N, 1, no flow control

WiFi Module 2	192.168.0.61
Port 1	Port Number 10001, TCP 115200. 8, N, 1, no flow control
Port 2	Port Number 10002, TCP 115200. 8, N, 1, no flow control

Camera	192.168.0.65 Port 8081
User ID	root
Password	drrobot

Advanced Network Settings

It's possible to use different network settings (e.g. IP) for the server PC, but the "Virtual Server" settings on the router must also be changed accordingly in order for the Internet remote monitoring feature to work properly.

You could also change the router settings such as IP and SSID etc,. If you need to do so, you are required to change the network settings on the WiFi modules on the robot by following the guidelines as illustrated on the WiFi Module manual.

Please contact support@DrRobot.com if you need further support.

Hardware Architecture

The diagram below illustrates the inter-connection between the core electronic circuits and modules (some are optional accessories).

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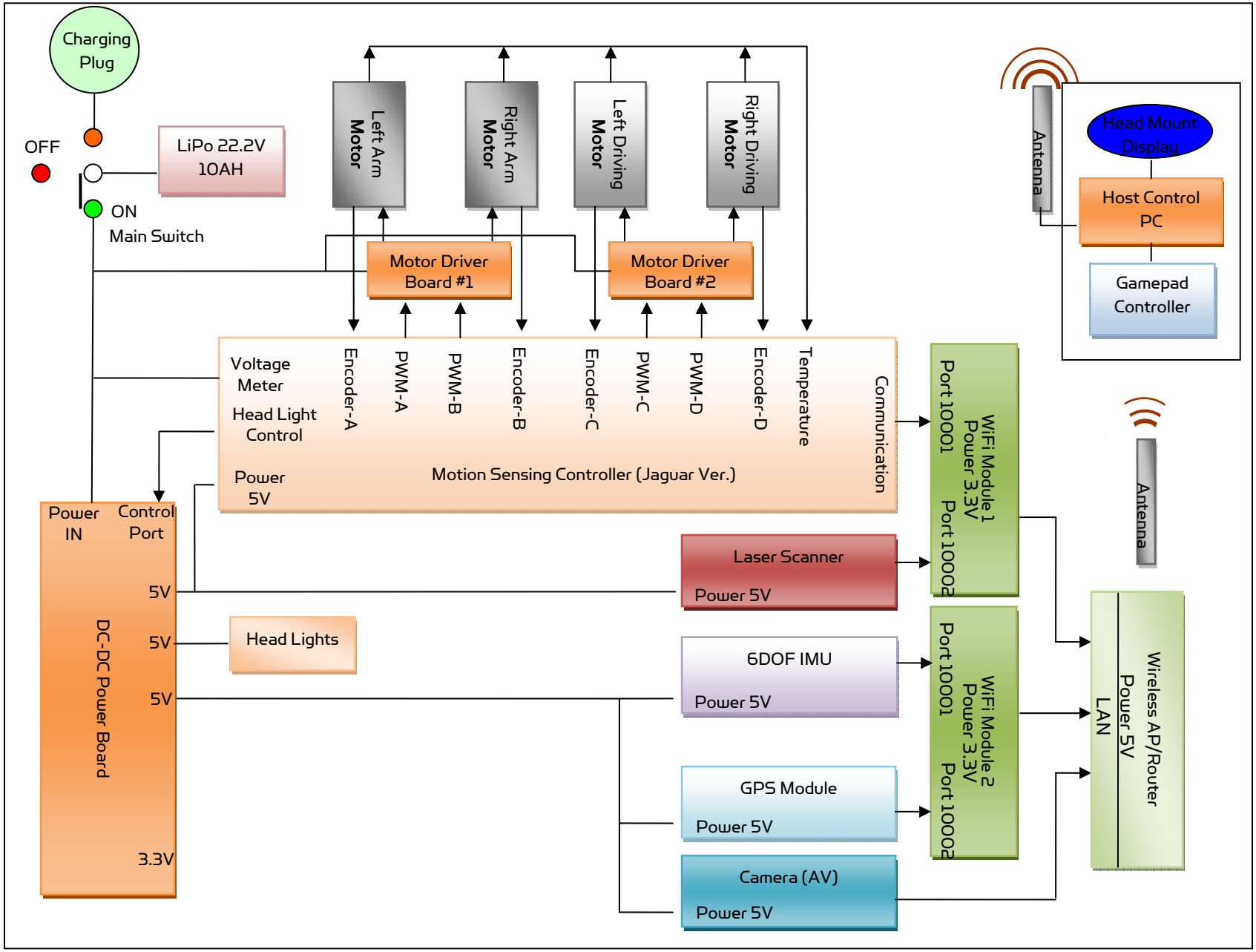

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Motor Driver Board

Two motor driver boards are used, one for the left and right track/wheel motors while the other one is for the arm-tack motors.

Input power	H-Bridge 2 channels
Max current	up to 25A continuous power per channel, peak up to 50A per channel for a few seconds
Input voltage	6~24V, 30V absolute max

Motion and Sensing Controller

This is a special version of PMS5005 board.

Input power	5V
6 PWM output	Channel 0,1 for left and right arm-track Channel 3,4 for left and right track/wheel
Motor control mode	PWM control; Velocity control; Position control
Sensor sampling	4 Channel encoder: Channel 0,1 for left and right arm-track Channel 3,4 for left and right track/wheel
	Board voltage measuring
	Battery voltage measuring
	4 motor temperature measuring
	Other extended A/D channels (please contact Dr Robot).

Camera

Input power	5V
Lens	4.4 mm: 47° view*, F2.0, fixed iris, fixed focus
Light sensitivity	1-10000 lux, F2.0 0 lux with headlights LED on
Resolutions	640x480 to 160x120
Frame rate	H.264: 30 fps in all resolutions Motion JPEG: 30 fps in all resolutions PEG-4 Part 2: 30 fps in all resolutions
Video compression	H.264 (MPEG-4 Part 10/AVC), Motion JPEG MPEG-4 Part 2 (ISO/IEC 14496-2)
Audio streaming	Two-way
Other features	PIR motion sensor with configurable sensitivity. Max range: 6 m

GPS

Input power	5V
Update rate	5 Hz
Sensitivity	- 185dBW minimum
Accuracy	Standard GPS service: Position: <= 15m 95% typical Velocity: 0.1knot RMS steady state WAAS service: Position: <= 3m 95% typical
Output Interface	NMEA 0183, default GPRMC/GPGGA/GPGSA/GPVTG

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	Binary Output

9DOF IMU (Gyro, Accelerometer & Digital Compass)

Input power	5V
Gyro Sensors	LY530ALH - 300º/s single-axis gyro LPR530ALH - 300º/s dual-axis gyro
Accelerometers	3 Axis ADXL345 13bit resolution Max +/-16G
Magnetic Compass	3 Axis HMC5843 magnetometer
Output Frequency	50Hz Output all sensor raw data and processed data by on-board MCU through serial port

Laser Scanner

Two laser scanner options are available, one with measurement range of 0.02-4m, and other one is 0.1-30m.

Input power	5V
Detectable range	0.02-4m
Accuracy	0.02 to 1m: +/- 10mm 1 to 4m: 1%
Measurement Resolution	1mm
Angular Resolution	approx 0.36 degrees (360 degree/1024 partition)
Scanning angle	240 degrees

Input power	12 V
Detectable range	0.1-30m
Accuracy	0.1 to 10m: +/- 30mm
Measurement Resolution	1mm
Angular Resolution	approx 0.25 degrees (360 degree/1440 steps)
Scanning angle	270 degrees

Batteries

Battery type	Li-Po
Voltage	22.2V (6 cells, 3.7V/cell)
Capacity	10Ah
Discharge rate	Max 50A continuous, Max 100A peak
Max charge rate	10A
Cycle life	500-1000 times

Charger

Charger type	Balance Charger
Maximum charge current	5A
Maximum discharge current	5A
Power Input	100-240V

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Motor with Encoder

Jaguar (with arms)

Track-arm motors	DC motors with steel gearbox
Rated voltage	24V
Rated current	< 2.1A
Rated speed	63 RPM
Rated torque	20 Kg.cm x 2
Encoder resolution	1083 counts per revolution

Track-wheel motors (2 units)	DC motors with steel gearbox
Rated voltage	24V
Rated current	2.1A
Rated speed	122 RPM
Rated torque	16 Kg.cm
Encoder resolution *	722 counts per (motor shaft) revolution *

*After pulley-belt speed reduction (34:20), the controller read-in encoder resolution is: 722 x 34/20 = 1227.4 count per (wheel) revolution.

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V. Further Development & Programming

The Jaguar Control program

The Jaguar Control program is written with C# program with Visual Studio 2008 express under .Net 3.5 framework. You could download the development tools (Visual Studio 2008 express under .Net 3.5 framework) free from Microsoft. Please refer to the "Dr Robot Application Development Notes on C# Programming for Robot Control" for further information.

The control program uses the supporting components and libraries that should have been installed when you install the control program from the installation CD:

1. **DRROBOTSentinelCONTROL.OCX:** Please refer to "WiRobot SDK API Reference Manual.pdf" for detail.
2. **WiRobotGateway.exe**
3. **AXIS Media Control Library Set** These are the camera control component for the AXIS Mini Camera (P/N: AXCAM) used for Jaguar robot. Please refer to "AXIS Media Control SDK Help" for detail.

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Motion Control/Sensing System:

Jaguar comes with a special version of PMS5005 as its motion control and sensing board. It follows the Dr Robot WiRobotSDK protocol and user could control and access Jaguar by Dr Robot ActiveX control (DrRobotSentinelActivexControl.ocx) and WiRobot gateway program.

Based on the protocol, you can develop your own program on any system. You could request protocol sample code from Dr Robot using C++/Java. You should contact Dr Robot with any questions regarding SDK API and protocol.

The communication port is connected at WiFi module-I port 1.

Gateway program will connect to this board at 192.168.0.60, port 10001.

Here is C# sample code to control Jaguar System with ActiveX control,

`myJaguar` is DrRobotSentinelActiveXControl.

Arm Motor control: By default the system provides synchronized control, so the left/right arm motors only use channel 0 PWM signal, but you can get each encoder reading for left arm and right arm.

```
private void myJaguar_MotorSensorEvent(object sender, EventArgs e)
{
   //here reads back PWM value for all motors
      leftArmMotor.pwmOutput = myJaguar.GetMotorPWMValue1();
      rightArmMotor.pwmOutput = myJaguar.GetMotorPWMValue1();
   //right motor still uses PWM channel 0
      leftWheelMotor.pwmOutput = myJaguar.GetMotorPWMValue4();
      rightWheelMotor.pwmOutput = myJaguar.GetMotorPWMValue5();

      leftArmMotor.encoderDir = myJaguar.GetEncoderDir1();
      leftArmMotor.encoderPos = myJaguar.GetEncoderPulse1();
      leftArmMotor.encodeSpeed = myJaguar.GetEncoderSpeed1();

      rightArmMotor.encoderDir = myJaguar.GetEncoderDir2();
      rightArmMotor.encoderPos = myJaguar.GetEncoderPulse2();
      rightArmMotor.encodeSpeed = myJaguar.GetEncoderSpeed2();
 }
```

You can read board voltage(5V) and battery voltage in standard sensor Event.

```
private void myJaguar_StandardSensorEvent(object sender, EventArgs e)
{
      boardVol  = ((double) myJaguar.GetSensorBatteryAD1() / 4095 * 9);
      motVol = ((double) myJaguar.GetSensorBatteryAD2() / 4095 *
      33.749);
}
```

You can read motor temperature sensor in custom sensor event, function Trans2Temperature() is based on the sensor specification to translate AD value to temperature celcius degree.

Also you can read left/right wheel motor encoder in this event.

```
private void myJaguar_CustomSensorEvent(object sender, EventArgs e)
{
   //here can read back left wheel motor and right wheel motor
   encoder information
      leftWheelMotor.encoderPos = myJaguar.GetEncoderPulse4();
      leftWheelMotor.encodeSpeed = myJaguar.GetEncoderSpeed4();
```

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```
            leftWheelMotor.encoderDir = myJaguar.GetEncoderDir4();

            rightWheelMotor.encoderPos = myJaguar.GetEncoderPulse5();
            rightWheelMotor.encodeSpeed = myJaguar.GetEncoderSpeed5();
            rightWheelMotor.encoderDir = myJaguar.GetEncoderDir5();


         //temperature sensor here
            RightArmMotorTemp =
         Trans2Temperature((double)myJaguar.GetCustomAD7());
            leftArmMotorTemp =
         Trans2Temperature((double)myJaguar.GetCustomAD5());
            leftWheelTemp =
         Trans2Temperature((double)myJaguar.GetCustomAD6());

           rightWheelTemp =
         Trans2Temperature((double)myJaguar.GetCustomAD8());
      }
      NOCONTROL = -32768;
```

To stop all motor, you could use:

```
myJaguar.DcMotorPwmNonTimeCtrAll(16384, 16384, 16384, 16384, 16384,
16384);
```

To control track/arm motor using PWM control with value 32767 (full PWM) you could use:

```
myJaguar.DcMotorPwmNonTimeCtrAll(32767,NOCONTROL, NOCONTROL, NOCONTROL,
NOCONTROL, NOCONTROL);
```

or

```
myJaguar.DcMotorPwmNonTimeCtr(0,32767);
```

Using position control, move motor to encoder position 2000 in 2000 ms, you could use:

```
myJaguar.DcMotorPositionTimeCtrAll(2000,NOCONTROl,NOCONTROL,NOCONTROL,N
OCONTROL, NOCONTROL, 2000);
```

or

```
myJaguar.DcMotorPositionTimeCtr(0, 2000, 2000);
```

Using velocity control, move motor at encoder speed 200, you could use:

```
myJaguar.DcMotorVelocityNonTimeCtrAll(200,NOCONTROL,NOCONTROL,NOCONTROL
,NOCONTROL,NOCONTROL);
```

or

```
myJaguar.DcMotorVelocityNonTimeCtr(0,200);
```

Same for the track/wheel motor control, the left track/wheel motor is at PWM channel 3, right track/wheel motor is at PWM channel 4.

To control head lights, using expanded IO port bit7.

Turn off light: `myJaguar.SetCustomDOUT(expandedIO & 0x7f);`
Turn on light: `myJaguar.SetCustomDOUT(expandedIO | 0x80);`

Software watchdog: The system will auto stop all the motors if it does not received any data package in 5 second.

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Laser Scanner

Laser Ranger sensor (4m version, URG-04LX) is connected to WiFi module–1 port 2 after voltage level conversion. You could access the sensor data via TCP socket at port 10002 with IP 192.168.0.60.

Default settings for the serial port are: 115200, 8, N, 1, no flow control, TCP, port number 10002

Date and communication protocol could be found in "URG-04LX commspec_eg.pdf".

GPS

GPS sensor output interface is RS232 serial port, and connected to WiFi module-2 port 2 after voltage level conversion. You could access the sensor data via TCP socket at port 10002 with IP 192.168.0.61.

Default settings for the serial port are: 115200, 8, N, 1, no flow control, TCP, port number 10002

NMEA 0183 sentence is described in file "GPS18x_TechnicalSpecifications.pdf". GPS configuration tool is SNSRXCFG_200.exe

9DOF IMU (Gyro/Accelerometer/Compass)

The output interface for this IMU sensor module is serial port. It is connected to WiFi module-2 port 2. You could read from this sensor via TCP port 10001 at IP 192.168.0.61. Serial Port Settings: 57600, 8, N, 1, no flow control, TCP, port number 10001. The sensor output rate is 50Hz (20ms) with output format of ASICII.

It's easier to read with a terminal program since the sensors' measurements are reported in ASCII. DCM estimation and all measurements are delimited with ","characters as well as a carriage return and line feed at the end of the data frame.

Format:

"ANG,roll,pitch,yaw,AN,gyroY,gyroZ,gyroX,accelX,accleY,accelZ,magnetomX, magnetomY, magnetomZ"

After "ANG", roll, pitch, yaw are estimated angle value by on board DCM algorithm. The unit is degree.

After "AN", the data are raw AD value for each sensor. Please note that the accelX, Y, Z value have been adjusted by subtracting the offsets by on board firmware.

Sample data string:

"ANG,0,0,10,AN, 379,378,379,1,-2, 243,4096,-1558,256"

Camera with Two Way Audio

You need to install the camera ActiveX control on your system by running the "AXISMediaControlSDK.exe". You could find some sample codes (C++, C#, VB) in C:\Program Files\Axis Communications\AXIS Media Control SDK\samples and the corresponding SDK documents in C:\Program Files\Axis Communications\AXIS Media Control SDK\doc.

By using the Microsoft's "Windows Media Encoder 9" and Axis video capture driver, you could also access this camera in Intel's OpenCV as same as accessing a USB camera.

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Advanced Development

Please refer to document "GPS-IMU Sensor Module and Outdoor Autonomous Navigation Program" for detail on autonomous navigation programming using the Jaguar GPS and IMU system module.

Support and sample codes are available for using OpenCV, LabVIEW and MATLAB. Please contact support@drrobot.com for further information.

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